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RESEARCH NOTE

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SECOND-YEAR RESULTS OF DIRECT-SEEDING EXPERIMENTS IN THE WESTERN WHITE PINE TYPE USING SCREENS FOR RODENT CONTROL

By

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INTRODUCTION

The possibility of using direct seeding as a method for artificial regeneration in the western white pine type was demonstrated by first-year results presented in a previous report 1/ and is substantiated by second-year results presented in this report. These results were obtained on four latin square plots sown in the fall of 1937 and four more sown in the spring of 1938 on broadcast burned areas in the Coeur d'Alene and Kaniksu National Forests. Comparisons of germination, survival, and degree of stocking were made between ponderosa pine, western white pine, and Engelmann spruce; between spring and fall sowing; and between spots protected with conical screens and unprotected spots. At the end of the first growing season all screens were removed from the protected spots.

Two methods of spot preparation were used on these plots. One method consisted of merely scraping away the ashes and duff from a circular area about 18 inches in diameter and covering the seed with mineral soil to a depth of 3/8 inch for ponderosa pine and western white pine and 1/8 inch for Engelmann spruce.

1/ Schopmeyer, C. S. Direct seeding in the western white pine type. Applied Forestry Notes no. 90. Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana. May 1939.

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The second method, in addition to removal of ashes and duff, involved cultivation of the soil in the seed spots to a depth of approximately 6 inches. These two methods of spot preparation, however, were not significantly different in their effects on either germination or survival during the first growing season. Hence, the data on this comparison are combined in the presentation of results.

RESULTS

Stocking[2/]

The most important point brought out by the stocking data, shown in table 1, is the small decrease in stocking resulting from the loss of seedlings in their second year of growth. Average stocking in spots screened during the first year was reduced from 80 percent at the end of the first growing season to 76 percent at the end of the second growing season. When new seedlings resulting from delayed germination during the second growing season were included, average stocking at the end of the second year showed a net increase of 2 percent over the figure for the end of the first year.

Stocking in fall-sown spots, protected with screens during the first year, was 27 percent greater than in similarly treated spring-sown spots at the end of the first season but only 17 percent greater at the end of the second season, as shown in table 1. This decrease in the difference was caused not by a decrease in stocking in the fall-sown spots but by an increase in stocking in the spring-sown plots resulting from delayed germination during the second year. In the unscreened spots delayed germination increased stocking to such an extent, in those sown in the spring, that at the end of the second growing season stocking was essentially the same in both the spring- and fall-sown spots.

Screened spots of all species were much better stocked than unscreened spots, but the difference was much greater in spots sown with either of the two pines than in spots sown with Engelmann spruce. In the fall-sown category, at the end of the second year, screened spots of the two pines were 90 percent stocked while the unscreened spots were only 28 percent stocked. Screened and unscreened spots of Engelmann spruce were 91 and 76 percent stocked, respectively. These differences in stocking were established during the first growing season while the screens were in place and remained essentially the same during the second year after removal of the screens. Similar differences occurred between the screened and unscreened spots of the spring-sown category.

2/ "Stocking" in this paper refers to the number of spots containing one or more seedlings expressed as a percentage of the total number of spots sown.

Table 1.--Percentages of successful spots [1/] in direct-seeding plots after first and second growing seasons

Location of plots	Species	Season of sowing	First-year results: Germination	First-year results: Survival	Second-year survival: Without additional germination	Second-year survival: Including additional germination	Increase in stocking caused by additional germination
Percent of total number of spots screened during first year							
Kaniksu National Forest	Ponderosa pine	Fall	100	100	100	100	0
		Spring	76	64	63	73	10
	Western white pine	Fall	94	87	85	87	2
		Spring	43	32	27	36	9
Coeur d'Alene National Forest	Western white pine	Fall	95	92	81	83	2
		Spring	86	82	78	94	16
	Engelmann spruce	Fall	99	96	91	91	0
		Spring	99	90	83	89	6
	Mean of all species	Fall	97	94	89	90	1
		Spring	76	67	63	73	10
Mean of all screened spots			86	80	76	82	6
Percent of total number of unscreened spots							
Kaniksu National Forest	Ponderosa pine	Fall	27	24	23	23	0
		Spring	12	10	9	28	19
	Western white pine	Fall	29	19	18	22	4
		Spring	7	1	1	12	11
Coeur d'Alene National Forest	Western white pine	Fall	48	39	33	38	5
		Spring	23	20	18	58	40
	Engelmann spruce	Fall	94	84	76	76	0
		Spring	88	67	61	65	4
	Mean of all species	Fall	50	42	38	40	2
		Spring	32	24	22	41	19
Mean of all unscreened spots			41	33	30	40	10
Mean of all screened & unscreened spots			64	57	53	61	8

1/ Each percentage on fall sowing is based on 288 spots; each percentage on spring sowing is based on 192 spots.

Number of Seedlings Per Spot

In spots screened during the first year, fall sowing resulted in twice as many seedlings per stocked spot at the end of the second season as spring sowing. Screened spots had about three times as many seedlings per spot as unscreened spots. The average number of seedlings per stocked spot for each treatment is given in table 2.

The effect of delayed germination on the average number of seedlings per spot, shown in table 2, was not as pronounced as its effect on stocking, shown in table 1, because in many spots one or two seedlings came in where none existed before, thus increasing stocking but not the average number of seedlings per stocked spot.

Causes of Mortality

In general, average mortality was not great during the second year, being only 13 percent of the total number of seedlings present at the end of the first growing season on all plots. Second-year mortality was, however, very inconsistent with respect to both cause and magnitude among the various species and the various plots. Cutting, perhaps by rabbits, during the early spring of 1939 eliminated 33 percent of the white pine seedlings grown from fall-sown seed on one of the Coeur d'Alene plots. Frost heaving was extensive among the Engelmann spruce seedlings especially in the spring-sown spots where 10 percent of the seedlings were lost from this cause. A light infestation of midges similar in mode of attack to the bird's-eye pine midge, Retinodiplosis sp., occurred on one of the Kaniksu plots and killed 4 percent of the seedlings of western white pine and ponderosa pine. Drought took its toll throughout the plots but was not a major cause of mortality.

DISCUSSION

Delayed germination, although it had an appreciable effect on the results of this study, is not of practical importance in the development of a direct-seeding method. Delay in germination may result in decreased viability and increased destruction of seed by rodents if spots are unprotected. Hence, prompt and complete germination should be one of the requirements of a practical seeding method.

Seed of white pine was not sown in the spring in these experiments for the specific purpose of obtaining delayed germination. This seed was stratified at the Savenac Nursery for 6 weeks prior to sowing with the purpose of obtaining prompt germination after sowing. Apparently the stratification treatment used on this lot of seed was not done under suitable conditions for a sufficient length of time to induce prompt germination after spring sowing.

Table 2.--Average number of seedlings per stocked spot in direct-seeding plots after first and second growing seasons

Location of plots	Species	Season of sowing	First-year results			Second-year survival		Increase caused by additional germination
			Germination	No. left after thinning 1/	Survival	Without additional germination	Including additional germination	
Spots screened during first year								
Kaniksu National Forest	Ponderosa pine	Fall	24.4	15.0	14.2	13.7	13.7	0.0
		Spring	7.3	7.3	6.8	6.5	6.2	-0.3
	Western white pine	Fall	10.4	8.8	8.3	7.7	8.3	0.6
		Spring	3.5	3.5	3.2	3.3	3.3	0.0
Coeur d'Alene National Forest	Western white pine	Fall	30.4	13.5	13.0	11.5	12.2	0.7
		Spring	3.9	3.9	3.6	3.5	5.4	1.9
	Engelmann spruce	Fall	26.0	13.8	11.3	9.4	9.5	0.1
		Spring	25.6	14.2	11.9	9.8	10.8	1.0
	All species	Fall	22.8	12.8	11.7	10.6	10.9	0.3
		Spring	10.1	7.2	6.4	5.8	6.4	0.6
Mean of all screened spots			16.4	10.0	9.0	8.2	8.6	0.4
Unscreened spots								
Kaniksu National Forest	Ponderosa pine	Fall	1.7	1.7	1.5	1.5	1.5	0.0
		Spring	1.5	1.5	1.4	1.8	1.8	0.0
	Western white pine	Fall	1.5	1.5	1.5	1.4	1.5	0.1
		Spring	1.0	1.0	1.0	1.0	1.3	0.3
Coeur d'Alene National Forest	Western white pine	Fall	2.1	2.1	1.7	1.6	1.5	-0.1
		Spring	1.7	1.7	1.7	1.6	2.6	1.0
	Engelmann spruce	Fall	8.1	8.1	5.4	4.5	4.5	0.0
		Spring	9.6	9.6	7.5	6.5	6.7	0.2
	All species	Fall	3.4	3.4	2.5	2.2	2.2	0.0
		Spring	3.4	3.4	2.9	2.8	3.1	0.4
Mean of all unscreened spots			3.4	3.4	2.7	2.5	2.7	0.2
Mean of all screened & unscreened spots			9.9	6.7	5.9	5.3	5.6	0.3

1/ Thinning was done the latter part of June during the first growing season. All spots containing more than 15 seedlings were thinned so that no spots had more than 15 seedlings each.

Stratification of white pine and ponderosa pine seed, although it might stimulate germination after spring sowing, would increase seeding costs with no certainty of increasing the stocking percentage over that obtained by sowing in the fall. A crop of seedlings resulting from spring sowing, although it might be satisfactory in terms of the criterion of a successful plantation, probably would not be as good as a crop from fall sowing because of lesser root penetration and hence greater susceptibility to drought injury. These considerations added to the results of the experiment are ample reasons for using fall sowing in preference to spring sowing in direct-seeding practice.

Engelmann spruce, with a stocking at the end of the second year of 76 percent in unscreened spots sown in the fall, apparently can be grown without protection from rodents. In this study, however, white pine and spruce were sown on the same areas. On these areas, rodents seemed to prefer the white pine seeds perhaps because they are larger. If the small seeds of Engelmann spruce were the only ones available rodents might dig up and eat enough to cause a failure in stocking. Test sowings of spruce without the presence of seed of other species are proposed to determine more definitely whether or not protection is necessary for this species.

Test sowings of another small seeded species, western redcedar, have already demonstrated 3/ that adequate germination in spots sown with seed of this species can be obtained without protection from rodents.

To avoid unnecessary competition between seedlings within spots, the number of seedlings per spot should be controlled. In this experiment, initial germination counts showed that more seed was sown than was necessary. The number of seedlings per spot could be regulated to some extent if the germination percentage of the seed at the time of sowing and seedling mortality after germination were known. From these data and a suitable safety factor, a number of seeds per spot could be calculated, which, when sown, would insure an adequate crop of seedlings under normal conditions with the most economical use of seed and a minimum number of seedlings per spot.

The removal of screens from the protected spots at the end of the first year did not result in extensive damage to seedlings except on one plot where rabbits appeared to be abundant. First-year results, however, demonstrated that a satisfactory crop of white pine or ponderosa pine seedlings could not be obtained without protection from rodents. These results show, in general, that protection from rodents was necessary

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3/ Schopmeyer, C. S. The use of western red cedar in reforestation by direct seeding. Research Note no. 5. Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana.

for the larger seeded species during the first year, at least until the seedlings emerged. During the second year, however, this protection was not necessary.

Since screens are not practicable in large-scale seeding operations, subsequent tests were made using poisons for rodent control. These tests, made on broadcast-burned areas, were successful at the end of the first growing season.4/ Further tests of these poisoning treatments are planned for more severe sites to determine how extensively this method can be used successfully.

SUMMARY

The results of this experiment, 2 years after sowing, demonstrate the possibility of using direct seeding as a method of reforestation in the western white pine type.

Cultivation of seed spots previous to sowing resulted in stocking no better than that obtained by sowing seed in undisturbed mineral soil after removing ashes and duff.

In screened spots at the end of the second growing season, average stocking resulting from fall sowing of all species was 17 percent greater than that from spring sowing.

The use of conical screens for protection of fall-sown seeds of the large seeded species, western white pine and ponderosa pine, against the depredations of rodents during the first year after sowing, resulted in three times the percentage of successful spots obtained by sowing these species without protection. Stocking was unsatisfactory in unprotected spots of these two species. The difference was established during the first year and remained essentially the same during the second year.

Second-year mortality, without consideration of delayed germination, resulted in a loss of only 4 percent of the total spots after removal of screens at the end of first growing season.

Delayed germination in spring-sown spots caused a net increase of 12 percent in stocking at the end of the second growing season over stocking at the end of the first growing season.

The small seeded species, Engelmann spruce, was sown with satisfactory results in both the spring and fall seasons without, as well as with, the protection of screens. Stocking ranged from 65 percent for spring-sown unscreened spots to 91 percent for fall-sown screened spots at the end of the second year.

4/ Schopmeyer, C. S. Successful reforestation by direct seeding using poisons for rodent control Research Note no. 1. Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana. January 1940.